IOWA HIGHWAY RESEARCH BOARD (IHRB)
Minutes of April 24, 2015

Regular Board Members Present

K. Jones
M. Kennerly
T. Nicholson
S. Okerlund
R. Knoche
D. Schnoebelen
W. Weiss
R. Stutt
P. Mouw
K. Mayberry
R. Fangmann

Alternate Board Members Present

D. Claman
C. Poole

Members with No Representation

D. Miller
T. Wipf

Secretary – V. Goetz

Visitors

Halil Ceylan	Iowa State University
Shauna Hallmark	Iowa State University
Bob Steffes	Iowa State University
Peter Savolainen	Iowa State University
Paul Wiegand	Iowa State University
Donna Matulac	Iowa Department of Transportation
Gordon Smith	ICPA
Sung Hwan Kim	Iowa State University
Kasthurira Gopalakrishnan	Iowa State University
David Eash	USGS
Francis Todey	Iowa Department of Transportation
Melissa Serio	Iowa Department of Transportation
Wayne Sunday	Iowa Department of Transportation
David Lee	University of Iowa
Brian Gelder	Iowa State University

The meeting was held at the Iowa Department of Transportation Ames Complex, Materials East/West Conference Room, on Friday, April 24, 2015. The meeting was called to order at 9:00 a.m. by Vice-Chairperson Sarah Okerlund with an initial number of 12 voting members/alternates at the table.

1. Agenda review/modification

2. Motion to approve Minutes from the March 27, 2015 meeting

Motion to Approve by D. Schnoebelen; 2nd W. Weiss
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

3. FINAL REPORT, TR-662, *"Evaluating Roadway Subsurface Drainage Practices – Phase II",* Halil Ceylan, ($126,878).

BACKGROUND

The presence of subsurface drainage systems (e.g., granular bases or outlets) is generally believed to be beneficial to the performance of various pavement types. Well-performing subsurface drainage systems form an important aspect of pavement design for the Iowa Department of Transportation (DOT).

Iowa Highway Research Board (IHRB) Project TR-643 provided extensive insights into Iowa subsurface drainage practices and pavement subdrain outlet performance. However, that project's forensic testing and evaluation were carried out in a drought year and during October and November of 2012, when relatively little rainfall was recorded.

Based on the findings of IHRB Project TR-643, the Iowa DOT requested an expanded Phase II study to address several additional research needs, such as the effects of seasonal variation on subdrain outlet performance, condition of composite (HMA over JPCP) pavement subdrain outlets, and the characteristics of tufa formation.

OBJECTIVES

- Evaluate the effects of seasonal variation on subdrain outlet condition and performance
- Investigate the condition of composite pavement subdrain outlets
- Examine the effect of resurfacing/widening/rehabilitation on subdrain outlets
- Investigate the characteristics of tufa formation in Iowa subdrain outlets
- Identify a suitable drain outlet protection mechanism (such as a headwall) for Iowa based on a review of practices adopted by nearby states.

DISCUSSION

Q. The granular backfill is day lighted to the edge of the pavement. Did you look to see if those that are blocked had water in them, is the granular draining around the pipe?
A. We did not study that aspect in this project.
Q. What do you think it is about the recycled material that's causing the chemical reaction over the virgin material?
A. What happens when you recycle the existing pavement systems you are actually increasing the surface area and the fines. One recommendation is to screen these materials. So now there is unhydrated cement, and with the water rehydrates and as it goes out the outlet pipe it forms the tufa. More study is needed on what blend to virgin and recycled to mitigate to tufa formation.
Q. Did the plastic pipe work because it pumped the water out faster or was it just straining out of the pipe itself?
A. Yes, it was not restrained on the pipe itself.

Q. When you talked about the rodent guards was there any discussion of going back and removing them to prevent the tufa formation?
A. The guards have been removed from the standards. Bob Younie from Maintenance is in the TAC and I am not sure what they are deciding to do to go back to locations and remove guards already in place.

Motion to Approve by R. Knoche; 2nd R. Fangman
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

4. Match Fund Problem Statement: *"Installation Guidance for Centerline and Edgeline Rumble Strips in Narrow Pavements",* Peter Savolainen, Iowa State University, ($60,000).

BACKGROUND
The installation of centerline and/or edgeline rumble strips on two-lane rural highways is a proven safety countermeasure. Placement of both centerline and edgeline rumble strips can usually be accommodated within wide pavements (24 feet or greater paved width) without issue. However, proper placement of one or both is less straightforward for highways with paved widths less than 24 feet. This becomes especially difficult as widths approach 20 feet.

Contributing factors such as traffic volume, roadway alignment, and the presence of roadside hazards may suggest the use of one type of rumble strip over another. However, no guidance currently exists regarding the minimum paved width necessary to install both centerline and edgeline rumble strips, or which one to install when the installation of both is infeasible.

OBJECTIVES
The objective of this project is to develop guidance for the installation and placement of centerline and/or edgeline rumble strips in narrow pavements.

It is anticipated that the first step in this research would be the determination of a minimum "rumble-free" lane width that is tolerable for a majority of road users. This width could then be used to develop a matrix of rumble strip options for a range of narrow pavement widths. The proper combination and width of centerline and/or edgeline rumble strips to install might then depend on site conditions such as:

- Traffic volumes
- Shoulder width
- Roadside hazard rating
- Roadway alignment
- Presence of bicyclists

DISCUSSION
Q. How is this study different from the Michigan study?
A. Michigan was very aggressive researching five thousand miles of mostly primary system. When we compared the primary to secondary road there wasn't significant samples of the secondary roads. We did not collect any county data as part of that. So we really couldn't look at the full scale that we would like to for this project.
Q. Is there any way to involve the bicyclist in this process? It would be nice for them to have some voice or statement in this process.

A. This is a great suggestion. In the Michigan study they had an organization called the League of Michigan's bicyclists. We are not proposing this in this study because it is a higher risk with the narrower pavement but I think it makes sense to at least let them engage in the conversation.
Q. Have you considered the noise level with the rumble strips with residents close by?
A. When the rumble strip is struck it is less noise then when a semi travels by but it is definitely something we need to be aware of.

Motion to Approve by W. Weiss; 2nd D. Schnoebelen
Motion carried with 12 Aye, 0 Nay, 0 Abstaining.

5. Match Fund Problem Statement: *"Evaluation of Rural Intersection Treatments",* Shauna Hallmark, Iowa State University, ($80,000).

BACKGROUND
Rural intersection crashes can be very severe due to the high approach speeds present. Crashes at rural intersections are frequently a result of failure to yield. Various intersection treatments, such advance stop line rumble strips or overhead flashing beacons, have been used to alert drivers to the presence of an intersection but the effectiveness of the various treatments is not well documented. Newer treatments such as LED stop signs show promise but have not yet been fully evaluated.

OBJECTIVES
The objective of this research is to evaluate the effectiveness of rural intersection treatments on safety. In particular, the study will focus on which driver behaviors lead to unsafe conditions and evaluate how the treatments affect those behaviors. The study will focus on rural stop or yield control intersections.

DISCUSSION
Q. In the final report you stated crash reduction factors would not be part of it so what would the end product look like.
A. We look at how it changes their behavior when stopping.
Q. Would we be able to collect enough data to make it valid?
A. We will look at intersections with higher volume. We leave cameras up for a week and have found we have significant amounts of data.
Q. Have you considered looking at railroad crossings?
A. We will not with this study because it would be hard to tell what the behavior is because a train crossing is different from a traffic crossing intersection.
Q. What would be the Cost of the radar signs?
A. The cost of the LAD signs is around two thousand and goes up to four thousand five hundred with the radar.
Q. The LAD chevrons that were installed at Perry are you using a radar system at this location?
A. Yes that was a part of the highways for life project and only targeted the drivers that were speeding.
Q. With your minimum crashes on the main line is this going to be more targeted on the divided highways or is it going to be restricted?
A. We are mainly looking at two lane highways because once you get to four lanes it is a whole different situation.

Motion to Approve by R. Fangmann; 2nd K. Mayberry
Motion carried with Aye, 12 Nay, 0 Abstaining, 0.

6. **Match Funding Proposal:** *"Investigation of Stream-Channel and Watershed Delineations and Basin-Characteristic Measurements using LiDAR Data for Small Drainage Basins in Iowa Located Within the Des Moines Lobe Landform Region",* David Eash, U.S. Geological Survey, ($157,912).

BACKGROUND

With the availability of LiDAR (Light Detection and Ranging) data for Iowa (*http://www.iowadnr.gov/Environment/GeologyMapping/MappingGIS/LiDAR.aspx*) and the development of programs to enforce drainage networks on 3-meter LiDAR DEMs (digital elevation models) (Gelder, 2015), the delineation of accurate drainage networks needs to be determined for the appropriate enforcement of LiDAR DEMs and measurement of drainage-basin characteristics. The basin-characteristic measurements of stream-channel length, slope, density, and order have been identified as significant variables for the estimation of flood discharges (Eash and others, 2013; Eash, 2001), flow-duration discharges (Linhart and others, 2012), and low-flow discharges (Eash and Barnes, 2012) in Iowa. The constant of channel maintenance (CCM) basin characteristic was a significant variable in the development of flood-estimation equations for the Des Moines Lobe landform region (flood region 1; Eash and others, 2013). CCM is a measure of drainage density calculated as a ratio of drainage area divided by the total length of all mapped streams in the basin. However, the placement of channel initiation points has always been a matter of individual interpretation, leading to variances in stream definitions between analysts. Thus testing of different quantitative stream initiation methods on hydrologically enforced LiDAR DEMs, will provide different drainage-network delineations from which basin-characteristic measurements can be evaluated for the optimization of stream-channel delineations from LiDAR data. Side-by-side testing of basin-characteristic values measured for the total drainage area versus the "effective" drainage area of basins is needed to determine which watershed delineation provides the best predictive accuracy for flood estimation. The effective drainage area represents a subset of the total watershed area and is the area that actually contributes streamflow under "reasonable" flow conditions for a given storm event, such as a 20- or 2-percent annual exceedance-probability (AEP) 24-hour rainfall. Because the predictive accuracy of flood-estimation equations for watersheds located within the Des Moines Lobe landform region (Eash and others, 2013; Eash, 2001) is the poorest in the State, research is needed to improve the accuracy of stream-channel delineations and flood estimation within the Des Moines Lobe landform region.

OBJECTIVES

The proposed study will test at least four different quantitative methods to define stream initiation using 3-meter LiDAR data for 17 streamgages with drainage areas less than 50 square miles that are located within the Des Moines Lobe landform region in north-central Iowa. Table 1 lists the 17 streamgages that have been selected for inclusion in this study and figure 1 shows their location. All of these streamgages were included in the 2013 StreamStats flood-estimation study for Iowa in which 59 selected basin characteristics were measured for each streamgage using 1:24,000-scale data from stream networks, basin boundaries, and 10-meter DEMs (Eash and others, 2013). Watersheds for the 17 streamgages will be enforced using the method developed by Gelder (2015) for the Iowa Highway Research Board (IHRB) and at least

four stream initiation methods will be used to define channel initiation points and the downstream flowpaths. Possible stream initiation methods include (1) channelization (determined by local elevation difference), (2) channelization (determined by profile curvature), (3) aspect change, (4) grid order (similar to Strahler stream order, but starting at flow accumulation = 0), (5) analyst derived streamlines using the LiDAR as a reference, and (6) snapping 1:24,000-scale stream initiation points to high-flow accumulation cells. The stream initiation methods will then be used to define channelized flowpaths on the hydrologically enforced LiDAR DEMs, creating multiple sets of selected basin-characteristic values that will be measured for each streamgage. The 4-6 different quantitative methods to define stream initiation will be tested side-by-side for three watershed delineations (1) the total drainage-area delineation (which should be similar to a 0.2-percent AEP 24-hour rainfall), (2) an effective drainage-area delineation of basins based on a 2-percent AEP 24-hour rainfall, and (3) an effective drainage-area delineation based on a 20-percent AEP 24-hour rainfall producing 12-18 different data sets of basin-characteristic values for each streamgage watershed.

Basin-characteristic values for stream density (STRDEN), relative stream density (RSD), total stream length (STRMTOT), constant of channel maintenance (CCM), the number of first-order streams (FOSTREAM), and drainage frequency (DRNFREQ) will be measured for each streamgage watershed from at least four stream initiation methods and LiDAR DEMs. The 4-6 sets of LiDAR-measured basin-characteristic values for total drainage area will be evaluated and compared to 1:24,000-scale StreamStats-measured basin-characteristic values for total drainage area for determining optimum stream-channel delineations from LiDAR data.

Because a comparison of LiDAR-measured basin-characteristic values and 1:24,000-scale StreamStats-measured basin-characteristic values may not adequately determine optimum stream-channel delineations from LiDAR data, additional selected basin characteristics will be measured for each streamgage to also test optimum stream-channel delineations from LiDAR data using flood-estimation regression analyses. Expected moments algorithm/multiple Grubbs-Beck test (EMA/MGB), AEP streamgage analyses (Eash and others, 2013) will be updated through the 2014 water year for the 17 streamgages and regression analyses will be performed to identify which of the 12-18 sets of LiDAR-measured basin-characteristic values from the 4-6 stream initiation methods and the three watershed delineation methods are the most significant for the estimation of 50-, 20-, 10-, 4-, 2-, 1-, 0.5-, and 0.2-percent AEPs for the Des Moines Lobe landform region for drainage areas less than 50 square miles .

DISCUSSION

Q. Do you think what you receive from the Des Moines area can be translated through the whole state as far as the small water shed?
A. I don't know if the same stream initiation method that works for the Des Moines water would work for the rest of the state.
Q. Do we have enough gage sites that we are looking at in the region to change the region equation and stream stats?
A. These range in 50 square miles. We have 17 gages which isn't a large data set but I think it is an accurate number of stream gages.
Q. Is that all of them in the Des Moines Lobe that are under 50 square miles?
A. Yes
Q. In the budget part of this study were Brian is going to work on the first part then the last part is done USGS?
A. Brian will have the work completed on the first part of the study with 2015 getting the data layers created but most of our work will be done in 2016.

Motion to Approve by K. Jones; 2nd D. Claman
Motion carried with Aye, 12 Nay, 0 Abstaining, 0.

7. **PROPOSAL: TR-624,** *"Development of Quality Standards for Inclusion of High Recycled Asphalt Pavement Content in Asphalt Mixtures-Phase 3",* David Lee, University of Iowa, ($200,000).

BACKGROUND

The use of high RAP mixes is increasing due to both environmental and economical reasons. However, a high RAP mix can cause asphalt mixtures to stiffen due to the hardening effect of the aged binder in RAP materials. During the aging process of asphalt binders, the amount of maltenes is decreased and an increase in volume of asphaltenes as maltenes change to asphaltenes. Thus, there will be less maltenes to disperse asphaltenes throughout the aged binder structure. As a result, the aged binder would become harder and more viscous but less ductile, which could negatively affect the performance of the high RAP mixes in the field.

A low temperature cracking potential is a primary concern with high RAP mixtures. To minimize a low temperature cracking, various rejuvenators have been utilized in the past instead of bumping down a PG grade of the specified virgin asphalt for high RAP mixes. However, in some cases, the premature failures such as rutting have been observed from the high RAP mixtures with rejuvenators.

Rejuvenators can be made from lubricating oil extract or extender oil, which would be a great source of maltenes. However, rejuvenators may have certain amounts of saturates which may not be compatible with the asphaltenes in the aged binder. Therefore, two most critical issues associated with adding rejuvenators into the high RAP mixes would be: 1) the quality of diffusion of that rejuvenator into the aged binder and 2) the uniformity of rejuvenator dispersion within a high RAP mix and (Corbett 1975, Petersen 1984).

A diffusion process of a rejuvenator into the aged binder would progress during mixing and construction process but it would stop after a certain period of time. The diffusion rate would be influenced by the viscosity of maltenes in the aged binder and it would increase by increasing amounts of diluent oil fractions at higher temperature (Oliver 1974). As illustrated in Figure 1, a mechanism of rejuvenators in high RAP mixtures could be defined as the following four steps (Carpenter and Wolosick 1980):

1. A very low viscosity layer is formed surrounding the RAP by a rejuvenator.
2. The rejuvenator begins to penetrate into the aged binder and makes it softer.
3. Penetration continues as the inner layer viscosity decreases whereas the outer layer viscosity increases.
4. Balance in viscosity is reached after a certain amount of time.

OBJECTIVES

The main objectives of this phase 3 study are to provide the Iowa DOT with: 1) a screening method for approving rejuvenator products in asphalt mixtures and 2) a method of field

verification for HMA containing rejuvenators. To achieve these objectives, the following tasks will be performed: 1) evaluate the effectiveness of various rejuvenators to soften aged binders by employing analytical technologies to examine diffusion levels of various rejuvenators in the extracted asphalt, 2) perform rheological binder tests to determine the effects of rejuvenators on aged binder properties, 3) perform mechanistic mixture tests (HWT, DCT, dynamic modulus, flow number and fatigue test) to assess the effect of rejuvenators on high RAP mixtures, 4) build test sections with select rejuvenator(s) and perform laboratory tests of field loose mixtures and cores and 5) perform a condition survey of the test sections.

DISCUSSION

Q. How many rejuvenators are you planning on looking at in the laboratory?
A. We will pick one that is popular nationwide so we are looking at three to five rejuvenators.
Q. When you are doing a field trial do you have to blend this with the asphalt before?
A. Yes, this is mixed with the asphalt beforehand at the plant.
Q. Part of the research is to evaluate the laboratory methods?
A. Yes
Q. Do you feel confident that you will be able to test these mixes and be able to adjust?
A. We are confident when trying four different types of mixes and find out which one is the more appropriate.
Q. Is there a certain one that the industry is looking at?
A. These are mixes that are being used in the Iowa department of Transportation and recommended.

Motion to Approve by K. Jones; 2nd R. Stutt
Motion carried with Aye, 12 Nay, 0 Abstaining, 0.

8. PROPOSAL: *"Temporary Traffic Control Handbook for Local Agencies",* Paul Wiegand, SUDAS/Iowa State University, ($50,000).

BACKGROUND

The 2005 "Work Zone Safety" handbook is based on the 2003 edition of the Manual on Uniform Traffic Control Devices (MUTCD). The State of Iowa is currently using the 2009 edition as the state standard.

SUDAS staff has taken on the task to update the 2005 "Work Zone Safety" handbook. We have a committee of city, county, Iowa DOT, Iowa LTAP, and utility representatives providing feedback on revisions to update the handbook. However, the SUDAS budget will not be able to cover the costs of developing new drawings and printing and distributing the final handbook.

OBJECTIVES

Update the 2005 "Work Zone Safety" handbook to a new pocket sized temporary traffic control handbook. Will use a technical advisory committee (TAC) consisting of city, county, consultant, DOT, LTAP, and utility representatives. Final handbook will be printed, distributed, and used for training with local agencies.

Motion to Approve by K. Mayberry; 2nd R. Knoche
Motion carried with Aye, 12 Nay, 0 Abstaining, 0.

9. New Business

Leighton stated if you are not getting TRB's electronic newsletter to let you know when these publications are coming out contact the Library and he will help you get set up. Leighton will send out the link to the board members to sign up for the TRB newsletter.

10. Adjourn

The next meeting of the Iowa Highway Research Board will be held Friday, May 29, 2015, in the East/West Materials Conference Room at the Iowa DOT. The meeting will begin promptly at 9 a.m.

_____

Vanessa Goetz, IHRB Secretary